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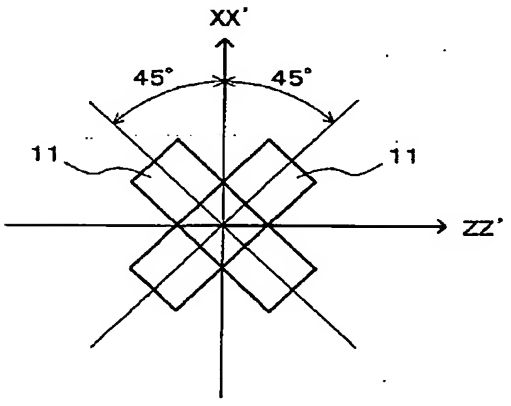
(54)【発明の名称】　ＳＣカットの水晶振動子

(57)【要約】
［目的］　応力感度特性が良好で、発振器自体の姿勢、外部からの応力の作用に係わらず高安定な発振周波数を維持することができるＳＣカットの水晶振動子を提供する。
［構成］　水晶の結晶のＹ軸に直交する面をＸ軸を中心にして約３３°回転し、この回転した位置からＺ軸を中心にして約２２°回転した面から切り出した短冊型のＳＣカットの水晶振動子において、水晶片１１の長手方向をＸＸ'軸から±４５°の方向とする。



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【特許請求の範囲】

【請求項１】水晶の結晶のＹ軸に直交する面をＸ軸を中心にして約３３゜回転し、この回転した位置からＺ軸を中心にして約２２゜回転した面から切り出した短冊型のＳＣカットの水晶振動子において、

水晶片の長手方向をＸＸ’軸から±４５゜の方向としたことを特徴とするＳＣカットの水晶振動子。

【請求項２】請求項１に記載のものにおいて、水晶片の表裏板面に相対面して形成した励振電極を水晶片の長手方向の一端部へ導出し、この励振電極の導出端部で水晶片を保持したことを特徴とするＳＣカットの水晶振動子。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、ＳＣカットの水晶振動子に係わり、とくにＢモードの副振動の抑圧に関する。

【０００２】

【従来の技術】近時、応力感度、熱衝撃特性、位相雑音性能等について優れた性能を有するＳＣカットの水晶振動子が注目されている。このようなＳＣカットの水晶振動子は、図３に示すように水晶の結晶のＹ軸に直交する面をＸ軸を中心にして約３３゜回転し、更にこの回転した位置からＺ軸を中心にして約２２゜回転した面から切り出した水晶片１に電極を形成したものである。

【０００３】このようなＳＣカットの水晶振動子の周波数・温度特性は８０℃付近に変極点を有する概略３次曲線状となる。一方、高安定度の水晶発振器として、８０℃程度の一定温度に加熱して動作させる恒温槽型の水晶発振器が知られている。このような発振器は、加熱用のヒータと、温度制御回路とを有し、ヒータの発熱量を制御することによって一定の温度を維持するようにしている。

【０００４】そして恒温槽型の水晶発振器では、水晶振動子を８０℃程度の一定温度に維持して安定な発振周波数を得るようにしている。しかして、ＳＣカットの水晶振動子では８０℃付近に変極点を有するために恒温槽型の水晶発振器として用いた場合、温度変化に対して発振周波数の変化率のもっとも少ない温度域で使用することになり一層安定な発振周波数を得ることができる。

【０００５】しかしながら、このようなＳＣカットの水晶振動子を用いた高安定水晶発振器は、１０－１０～１０－１１程度の安定度を有する周波数基準源として使用される。このため、応力感度特性の良好なこと、すなわち外部の応力に対する周波数の変化の極力少ないことを要求される。

【０００６】

【発明が解決しようとする課題】本発明は上記の事情に鑑みてなされたもので、応力感度特性が良好で、発振器自体の姿勢、外部からの応力の作用に係わらず高安定な

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発振周波数を維持することができるＳＣカットの水晶振動子を提供することを目的とするものである。

【０００７】

【課題を解決するための手段】本発明の請求項１は、水晶の結晶のＹ軸に直交する面をＸ軸を中心にして約３３゜回転し、この回転した位置からＺ軸を中心にして約２２゜回転した面から切り出した短冊型のＳＣカットの水晶振動子において、水晶片の長手方向をＸＸ’軸から±４５゜の方向としたことを特徴とし、請求項２は請求項１に記載のものにおいて、水晶片の表裏板面に相対面して形成した励振電極を水晶片の長手方向の一端部へ導出し、この励振電極の導出端部で水晶片を保持したことを特徴とするものである。

【０００８】

【実施例】以下、本発明の一実施例を図１に示す電極を形成した水晶片の平面図を参照して詳細に説明する。図中１１は水晶片で、たとえば図３に示すように人工水晶の結晶のＹ軸に直交する面をＸ軸を中心にして約３３゜回転し、さらにこの回転した位置からＺ軸を中心にして約２２゜回転したＳＣ板から短冊状に切り出したものである。

【０００９】ここで、短冊型の水晶片の長手方向をＸＸ’軸の方向から１０゜づつ面内回転させた１８種類のサンプルを製作して、それぞれのサンプルについて応力感度特性を測定した。サンプルの水晶片の共振周波数は１１ＭＨｚで、水晶片の表裏板面に相対面して形成した励振電極を長手方向の一端部へ導出し、この導出端部で片持ち支持を行うようにした。そして水晶片の長手方向の他端部を加圧した際の共振周波数の変化を測定した。

【００１０】図２は応力感度特性の測定結果を示すグラフである。このグラフから明らかなように短冊型の水晶片の応力感度特性は面内回転角度に応じて略連続的に変化し、短冊の長手方向がＸＸ’軸から０゜で＋側に最大、９０゜で一側に最大となり、その周波数偏差は、それぞれ約３ｐｐｂ／Ｎである。また、長手方向がＸＸ’軸から４５゜及び１３５゜で応力感度特性は原点を横切るために最小０となる。

【００１１】したがって外部からの応力、あるいは姿勢差による周波数変化を最小にするためには短冊型のＳＣカットの水晶片の場合、長手方向をＸＸ’軸から４５゜又は１３５゜、すなわち長手方向をＸＸ’軸から±４５゜の方向とすることが望ましい。

【００１２】このようにすれば、外部からの応力、姿勢差等による周波数の変化を最小にすることができ、たとえば恒温槽型の発振器の場合１０－１０程度の高安定で外部からの応力、姿勢差による発振周波数の変化の極めて少ない発振出力を得ることができる。

【００１３】

【発明の効果】以上詳述したように、本発明によれば、応力感度特性が良好で外部からの応力、姿勢差による周

波数変化を最小にすることができ共振周波数を高安定度に維持することができるＳＣカットの水晶振動子を提供することができる。

【図面の簡単な説明】

【図１】本発明の一実施例の水晶片の切り出し角度を説明する図である

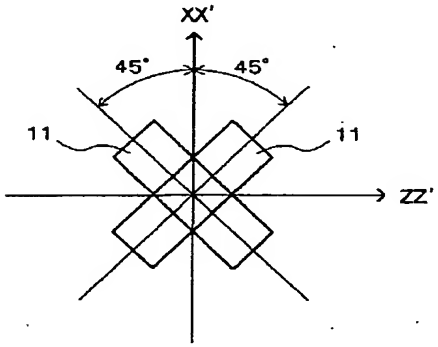
＊【図２】水晶片の切り出し角度と応力感度との関係を示すグラフである。

【図３】ＳＣカットの水晶片の切り出し角度を説明する図である。

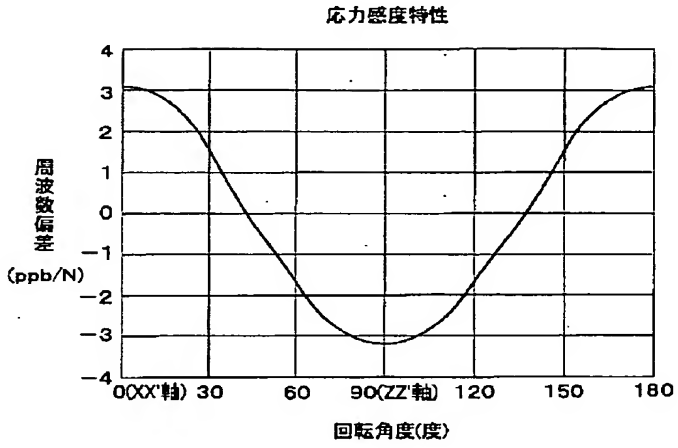
【符号の説明】

１１　　・・　水晶片

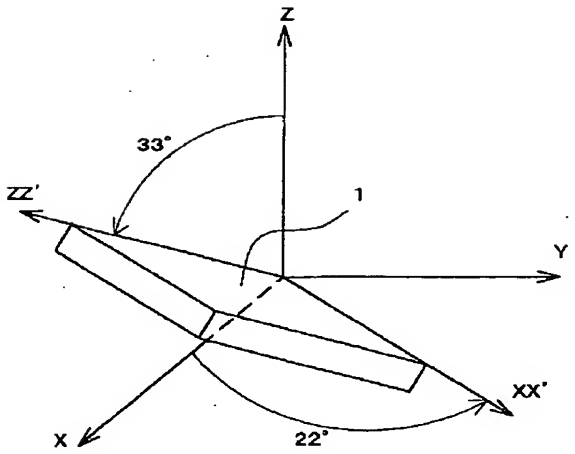
【図１】



【図２】



【図３】



PATENT ABSTRACTS OF JAPAN

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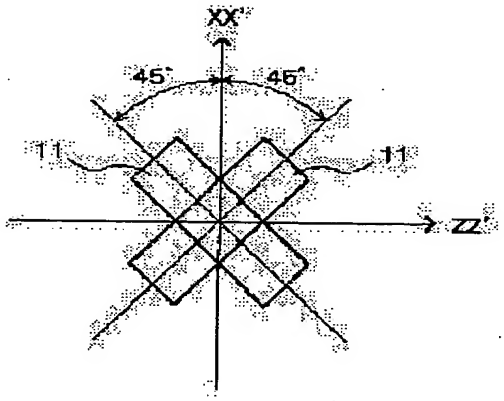
(71)Applicant : NIPPON DEMPA KOGYO CO LTD
(72)Inventor : KOYAMA MITSUAKI
SAITO MIKIO

(54) SC-CUT CRYSTAL RESONATOR

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an SC-cut crystal resonator with a satisfactory stress sensitivity characteristic to maintain a highly stable oscillation frequency irrespective of the posture of the resonator itself and of a stress from outside by setting the longitudinal direction of a crystal piece to a specified angle from an XX'-axis.
SOLUTION: A crystal piece 11 is obtained by rotating a face orthogonal to the Y-axis of artificial rock crystal with an X-axis as a center and cutting it in an oblong form from an SC board rotated from the rotated position by 22 degrees with a Z-axis as its center. Stress sensitivity characteristic of the crystal piece 11 in the oblong form almost continuously changes in accordance with an intra-face rotation angle and the longitudinal direction of the oblong form becomes maximum on a '+' side by 0 degree from the XX-axis and becomes maximum on a '-' side by 90 degrees. Since the stress sensitivity characteristic crosses an original point and it becomes minimum '0' when the longitudinal direction is between 45 degrees and 135 degrees. For making a frequency change by stress from outside or a posture difference to be minimum, it is desirable to set the longitudinal direction to be the direction of ±45 degree from the XX'-axis in the case of an oblong SC-cut crystal piece 11.



LEGAL STATUS

[Date of request for examination]	22.03.2001
[Date of sending the examiner's decision of rejection]	24.09.2002
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	

[Date of requesting appeal against examiner's decision of rejection]
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CLAIMS

[Claim(s)]
[Claim 1] The quartz resonator of SC cut characterized by making the longitudinal direction of the Xtal piece into a **45-degree direction from XX' shaft in the quartz resonator of SC cut of the stick-shape cut down from the field which rotated about 33 degrees of fields which intersect perpendicularly with the Y-axis of the crystal of Xtal focusing on the X-axis, and was rotated about 22 degrees focusing on the Z-axis from this rotated location.
[Claim 2] The quartz resonator of SC cut characterized by having drawn the excitation electrode which carried out the phase confrontation, and which was formed in the table backing side of the Xtal piece in the thing according to claim 1 to the end section of the longitudinal direction of the Xtal piece, and holding the Xtal piece at the derivation edge of this excitation electrode.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to oppression of the seiche of an B mode with respect to the quartz resonator of SC cut.
[0002]
[Description of the Prior Art] Recently, the quartz resonator of SC cut which has the engine performance which was excellent about stress sensitivity, a thermal shock property, the phase noise engine performance, etc. attracts attention. The quartz resonator of such an SC cut forms an electrode in the Xtal piece 1 started from the field which rotated about 33 degrees of fields which intersect perpendicularly with the Y-axis of the crystal of Xtal focusing on the X-axis as shown in drawing 3 , and was further rotated about 22 degrees focusing on the Z-axis from this rotated location.
[0003] The frequency and the temperature characteristic of the quartz resonator of such an SC cut serve as the shape of a 3rd outline curve which has the strange pole near 80 degree C. On the other hand, the crystal oscillator of the thermostat mold which it heats [mold] to the constant temperature of about 80 degrees C, and operates it as a crystal oscillator of high stability is known. Such an oscillator has a heater for heating, and a thermal control circuit, and he is trying to maintain fixed temperature by controlling the calorific value of a heater.
[0004] And he maintains a quartz resonator in constant temperature of about 80 degrees C, and is trying to obtain a stable oscillation frequency in the crystal oscillator of a thermostat mold. A deer is carried out, in the quartz resonator of SC cut, since it has the strange pole near 80 degree C, when it uses as a crystal oscillator of a thermostat mold, it will be used to a temperature change in fewest temperature regions of the rate of change of an oscillation frequency, and a much more stable oscillation frequency can be obtained.
[0005] However, the high stability crystal oscillator using the quartz resonator of such an SC cut is used as a frequency reference standard which has about 10-10 to ten to 11 stability. For this reason, it is required that there is it as much as possible, little a stress sensitivity property is good, i.e., change of the frequency to external stress.
[0006]
[Problem(s) to be Solved by the Invention] what was made in view of the situation of the above [this invention] — it is — a stress sensitivity property — good — irrespective of the position of the oscillator itself, and an operation of the stress from the outside — high — it aims at offering the quartz resonator of SC cut which can maintain a stable oscillation frequency.
[0007]
[Means for Solving the Problem] In the quartz resonator of SC cut of the stick-shape cut down from the field which claim 1 of this invention rotated about 33 degrees of fields which intersect perpendicularly with the Y-axis of the crystal of Xtal focusing on the X-axis, and was rotated about 22 degrees focusing on the Z-axis from this rotated location It is characterized by making the longitudinal direction of the Xtal piece into a **45-degree direction from XX' shaft, and claim 2 is set to a thing according to claim 1. The excitation electrode which carried out the phase confrontation and which was formed in the table backing side of the Xtal piece is drawn to the end section of the longitudinal direction of the Xtal piece, and it is characterized by holding the

Xtal piece at the derivation edge of this excitation electrode.
[0008]
[Example] It explains to a detail with reference to the top view of the Xtal piece which formed hereafter the electrode which shows one example of this invention to drawing 1 . 11 in drawing is started in the shape of a strip of paper from SC plate which is the Xtal piece, for example, rotated about 33 degrees of fields which intersect perpendicularly with the Y-axis of the crystal of synthetic rock crystal focusing on the X-axis as shown in drawing 3 , and rotated about 22 degrees focusing on the Z-axis from this rotated location further.
[0009] Here, 18 kinds of samples to which the field internal version of every 10 degrees of the longitudinal directions of the Xtal piece of stick-shape was carried out from XX' shaft orientation were manufactured, and the stress sensitivity property was measured about each sample. The resonance frequency of the Xtal piece of a sample was 11MHz, draws the excitation electrode which carried out the phase confrontation and which was formed in the table backing side of the Xtal piece to the end section of a longitudinal direction, and was made to perform a cantilevered suspension at this derivation edge. And change of the resonance frequency at the time of pressurizing the other end of the longitudinal direction of the Xtal piece was measured.
[0010] Drawing 2 is a graph which shows the measurement result of a stress sensitivity property. The stress sensitivity property of the Xtal piece of stick-shape carries out abbreviation per-continuum change according to a field internal-version include angle, the longitudinal direction of a strip of paper serves as max from XX' shaft at 0 degree, and serves as max at 90 degrees at - side at + side so that clearly from this graph, and that frequency deviation is about 3 ppb/N, respectively. Moreover, a longitudinal direction is set to a minimum of 0 from XX' shaft, in order that a stress sensitivity property may cross a zero at 45 degrees and 135 degrees.
[0011] Therefore, in order to make frequency change by the stress or the position difference from the outside into min, in the case of the Xtal piece of SC cut of stick-shape, it is desirable for 45-degree ** to make a longitudinal direction 135 degrees from XX' shaft, and to make a longitudinal direction a **45-degree direction from XX' shaft.
[0012] thus, Takayasu who is ten to about ten when change of the frequency by the stress from the outside, a position difference, etc. can be made into min, for example, it will be the oscillator of a thermostat mold, if it carries out — the stress from the outside and very little oscillation output of change of the oscillation frequency by the position difference can be obtained by the law.
[0013]
[Effect of the Invention] As explained in full detail above, according to this invention, the quartz resonator of SC cut which a stress sensitivity property can be good, can make min frequency change by the stress from the outside and the position difference, and can maintain resonance frequency to high stability can be offered.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing explaining the logging include angle of the Xtal piece of one example of this invention.
[Drawing 2] It is the graph which shows the relation between the logging include angle of the Xtal piece, and stress sensitivity.
[Drawing 3] It is drawing explaining the logging include angle of the Xtal piece of SC cut.
[Description of Notations]
11 .. Xtal Piece

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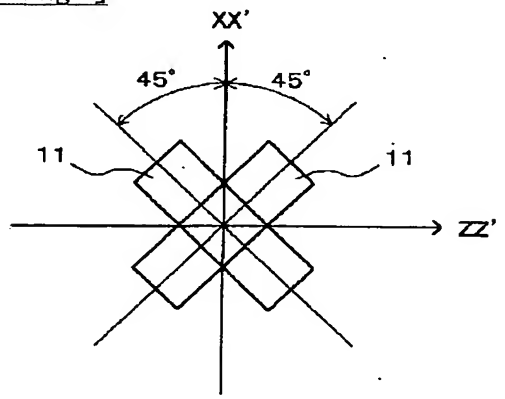
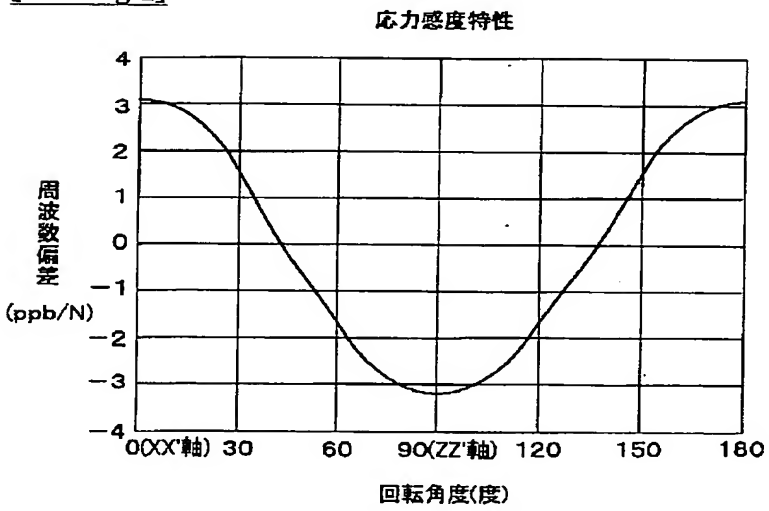
DRAWINGS

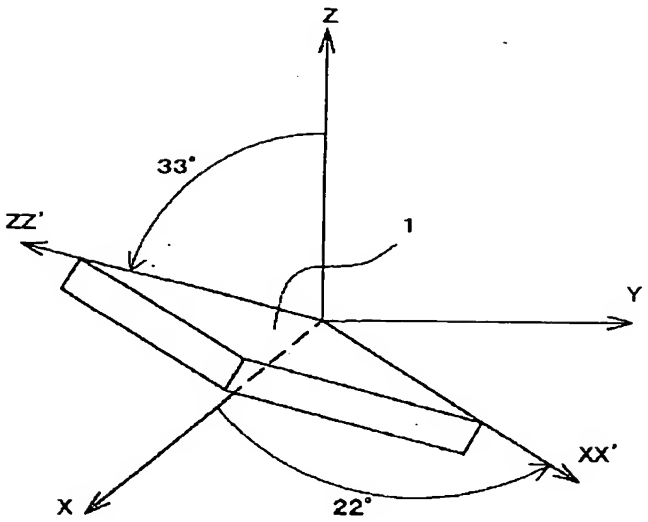
[Drawing 1]



[Drawing 2]



[Drawing 3]



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